

***Arisaema inaense* and *A. nagiense*, Two Diploid Species of the *A. ovale* Group (Araceae)**

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Based on morphology and chromosome numbers, *Arisaema inaense* (Seriz.) K. Sasamura et J. Murata is newly recognized at the rank of species and a new species *A. nagiense* T. Kobayashi, K. Sasamura et J. Murata is described. Both are diploid with $2n = 26$ and lack the accessory buds that always accompany the axillary buds of tetraploid plants of *A. ovale* Nakai. In the *A. ovale* group, *A. nagiense* is unique in the inflorescence unfolding before the leaf blade.

Key words: *Arisaema ovale* group, *A. inaense*, *A. nagiense*, chromosome, new species

When Murata (1986) revised *Arisaema amurense* Maxim. and allied taxa, *A. ovale* was recognized as a distinct species characterized by having axillary buds accompanied by accessory buds, the spathe tube with raised longitudinal stripes and a chromosome number with multiples of 13 ($2n = 26, 39, 52$). *Arisaema ovale*, in the sense of Murata (1986), included two varieties, *sadoense* (Nakai) J. Murata and *inaense* (Seriz.) J. Murata. Based on its morphological distinctiveness, Serizawa (1988) proposed to raise var. *inaense* to the rank of species, but his nomenclatural proposal was invalid.

Murata (1990) reported *A. ovale* (var. *sadoense*) to be a pentaploid ($2n = 65$) from Hokkaido and *A. ovale* var. *inaense* a diploid ($2n = 26$, data shown in Murata *et al.* 2006), and that accessory buds characteristic of tetraploid plants of *A. ovale* were not found in diploid plants of either var. *sadoense* or var.

inaense. Murata (1993) agreed with Serizawa's (1988) opinion, but did not change the taxonomic status of var. *inaense*.

In 2006 the first author (Kobayashi) observed unusual plants on Nagi-san in Okayama Prefecture, Japan, which were similar to but appeared distinct from *Arisaema ovale*. The plants were included in an extensive study of the *A. ovale* group (equivalent to *A. ovale* in the sense of Murata (1986)), which was revealed to be monophyletic in the ongoing molecular phylogenetic study of *Arisaema* (Ohi-Toma *et al.* unpublished). As a result of those studies we recognize two additional taxa of the *A. ovale* group as distinct species.

Measurements of morphological characters were taken from specimens in the herbaria of AICH, TI, and TNS, and from living individuals in the field. Root tips removed from living plants were

used for observing the somatic chromosomes. Root tips were pretreated with cold water at 0°C for 24 hours and fixed in 3:1 ethanol-acetic acid for 3 hours at 4°C. Then they were macerated in 1N HCl for 10 minutes at 60°C, stained with Schiff's solution and squashed.

Arisaema inaense (Seriz.) Seriz. [in Gifu-ken Shokubutsu Kenkyu Kaishi 5: 7 (1988), comb. nud.] ex K. Sasamura & J. Murata, **stat. nov.** (Fig. 1A–C)

Basionym: *Arisaema amurense* Maxim. var. *inaense* Seriz. in Acta Phytotax. Geobot. 32: 25, f. 2 (1981). — *Arisaema ovale* Nakai var. *inaense* (Seriz.) J. Murata in J. Fac. Sci. Univ. Tokyo sect. 3, Bot. 14: 66 (1986); Aroideana 13: 37, f. 8 (1990). — Type: JAPAN. Near Shirabi-daira, E. foot of Mt. Kiso-Komagatake, Komagane-shi, alt. ca. 1600 m, June 8, 1979, S. Serizawa 29715 (holo- AICH).

Paradioecious herbs, 25–50 cm tall. *Tuber* depressed globose, 1.5–5 cm wide; phyllotaxis spirodistichous; tuberlet one in each leaf axil. *Leaf* 1, pseudostem 10–25 cm long, mouth narrowly expanded, collar-like; petiole nearly as long as pseudostem; blade digitately or pedately 5-foliolate; leaflets entire, green; terminal leaflet usually petiolulate, elliptic, base cuneate, apex acuminate, 6–25 cm long, 1.5–10 cm wide. *Inflorescence* unfolding after leaf blade; peduncle much shorter than pseudostem and petiole; spathe dusty brownish purple, with white veins; tube 4.5–5.5 cm long, cylindrical, gradually opening to narrowly auriculate mouth, longitudinal white veins distinctly raised outside; blade curved forward, obovate, apex acuminate, 8–9 cm long, 3.5–4.5 cm wide. *Spadix* unisexual; appendage pale green, thickly cylindrical, upright, 3.5–4.5 cm long, 7–9 mm wide, basally truncate and stipitate, apex weakly capitate. *Staminate flowers* of 2 or 3 fused stamens, anther cells globose, dehiscing by short slits to pores. *Ovaries* congested, green, bottle-shaped.

Japanese name. Ina-hiroha-ten'nansho.

Chromosome number. $2n = 26$ (Murata *et al.* 2006).

Distribution. Japan: Honshu (Nagano and Gifu Prefs.).

Other specimens examined. JAPAN. Nagano Pref.: between Shirabidaira and Kitagosho-dani Deai, Mt. Kisokomagatake, Komagane-shi, alt. ca. 1600 m, 8 Jun. 1979, S. Serizawa 29714, 29716 (AICH); Kisomidai, Kisokoma-kogen, Kisofukushima-machi, alt. 1500–1600 m, 27 Jun. 1986, S. Serizawa 44161 (AICH); Kisomidai, Kisofukushima-machi, alt. ca. 1550 m, 31 May 1987, S. Serizawa 45731–45738 (AICH); Azumi-gun, Nakabusa, Jun. 1992, J. Murata s.n. (TI). — Gifu Pref.: Oshikiji National Forest, Niugawa-mura, alt. ca. 1500 m, 6 Jun. 1986, S. Serizawa 44023-a, 44023-b, 44024 (AICH); Sengendaru National Forest, Hiwada-kogen, Takane-mura, alt. 1520–1580 m, 7 Jun. 1986, S. Serizawa 44052–44063 (AICH).

As suggested by Serizawa (1988), *Arisaema inaense* (Fig. 1D) is distinct from *A. ovale* in having a purplish spathe with clear white longitudinal stripes, a narrowly auriculate mouth, pentagonal ovate blade and thick subcapitate spadix appendage. *Arisaema inaense* is scattered in the upper *Fagus* zone in Nagano and Gifu Prefectures in central Honshu and occasionally grows with *A. ovale* (tetraploid), but it is distinct from the latter also in the nature of the axillary buds (tuberlets) that do not accompany accessory buds.

Arisaema nagiense T. Kobayashi, K. Sasamura & J. Murata, **sp. nov.** (Fig. 1D–E)

Simile *Arisaemati ovali* sed gemmis solitariis, pedunculis longioribus, spathae limbo atropurpureo angustiore differt.

Typus. JAPAN. Hyogo Pref., Siso City, Chigusacho, Mt. Nabegataniyama, alt. 1200–1250 m, May 23, 2007, T. Kobayashi 42827 (holo- TI, Fig 2).

Paradioecious herbs, 10–40 cm tall. *Tuber* depressed globose, 1–3 cm wide; phyllotaxis spirodistichous; tuberlet one per leaf axil. *Leaf* 1, seldom 2, pseudostem usually purplish, 6–28 cm long, mouth narrowly expanding, collar-like; petiole 4–15 cm long; blade digitately or pedately 5-foliolate; leaflets entire, green; terminal leaflet petiolulate, narrowly

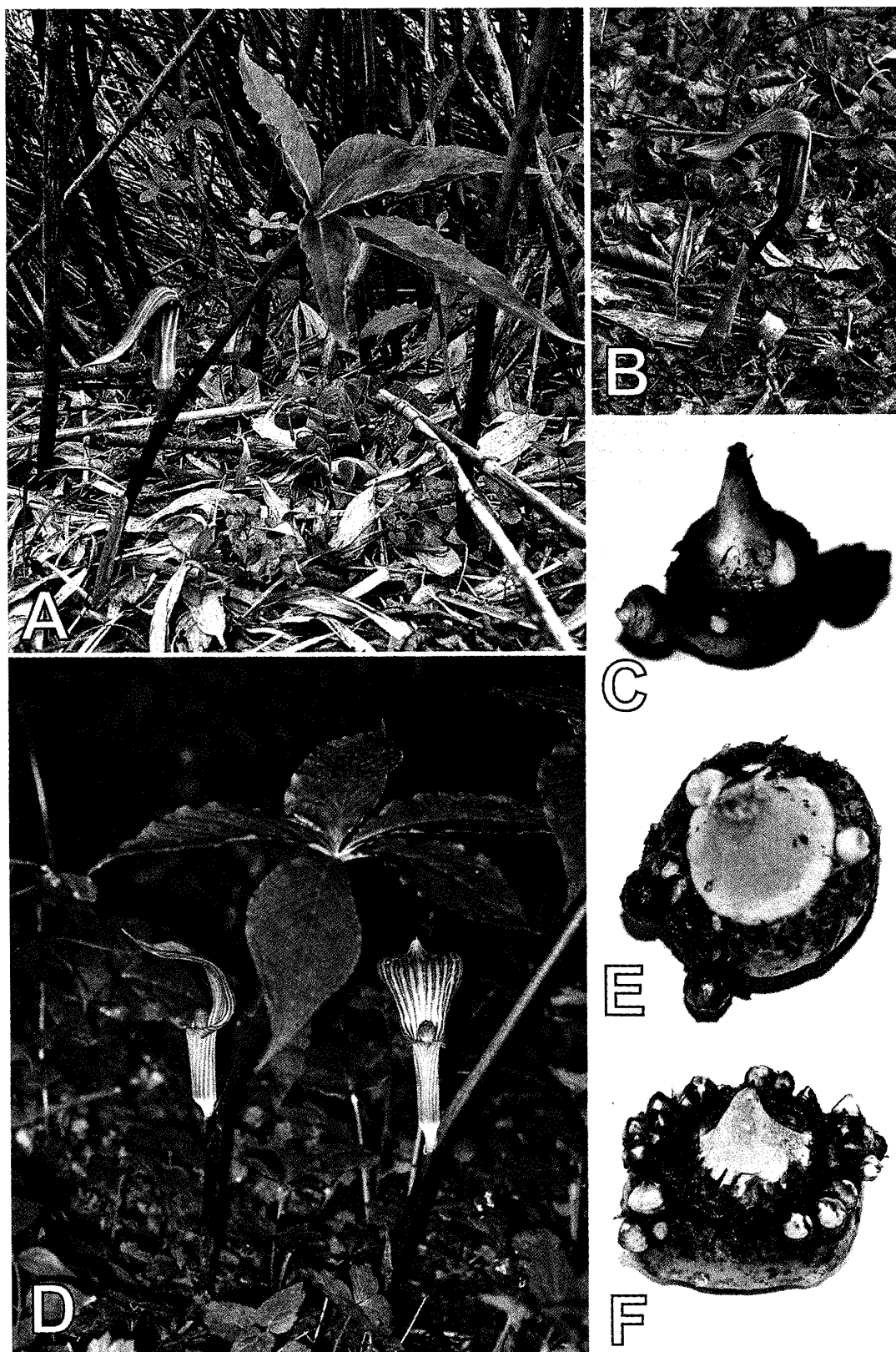
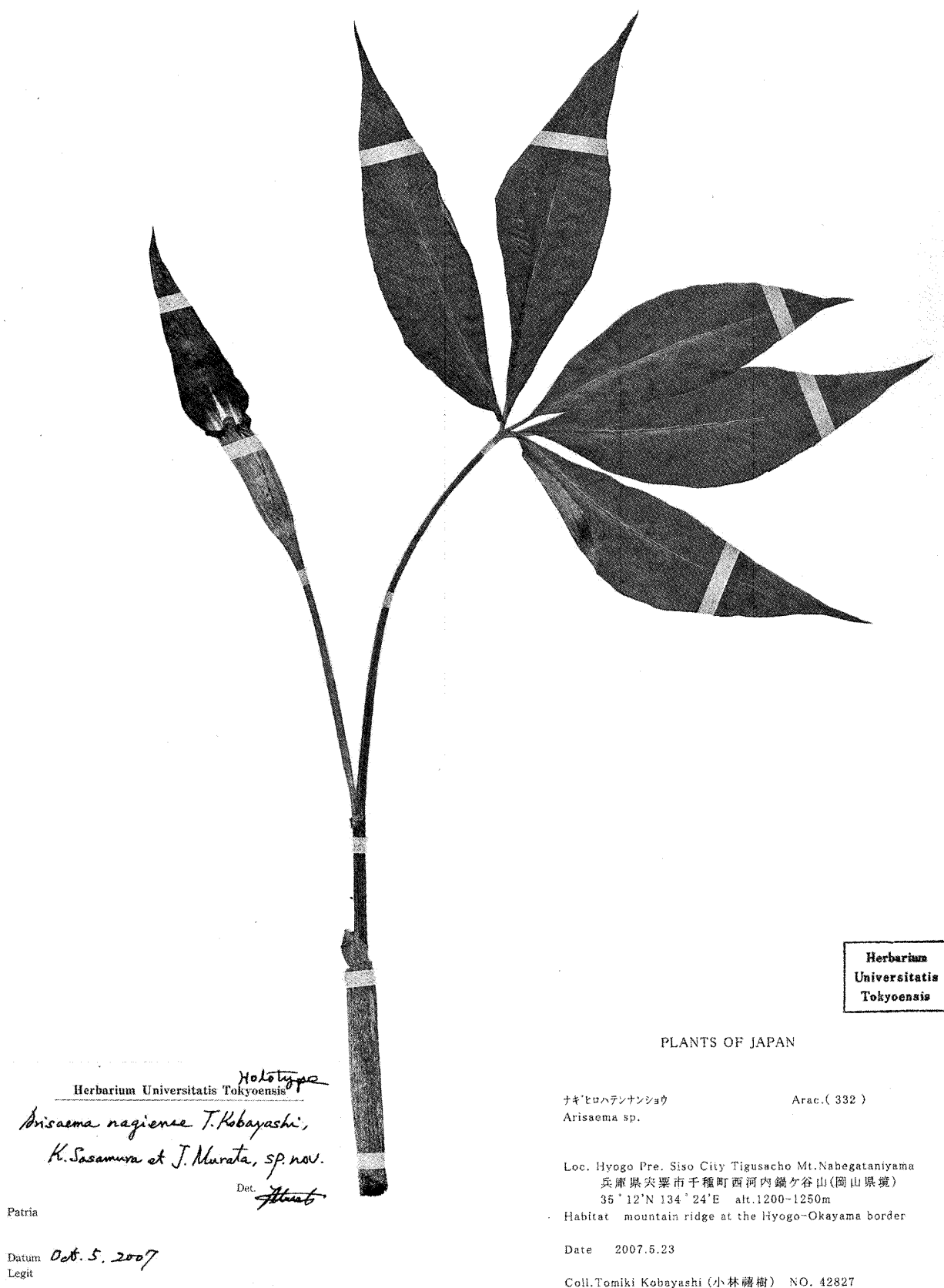


FIG. 1. Habit and underground stems of *Arisaema ovale* group. A-B: *Arisaema nagiense* from vicinity of Nabegataniyama, Hyogo Pref. C: Tuber of *A. nagiense* from Nagisan, Okayama Pref. D-E: *Arisaema inaense* from Ariake-cho, Nagano Pref. F: Tetraploid individual of *Arisaema ovale* from Nagisan, Okayama Pref. (K. Sasamura et al. 529, TI). Axillary buds of diploid species (C, E) and diploid plants of *A. ovale* are solitary while they are always accompanied by accessory buds (F) in polyploid plants.



Herbarium
Universitatis
Tokyoensis

PLANTS OF JAPAN

Herbarium Universitatis Tokyoensis

Arisaema nagiense T. Kobayashi,
K. Sasamura et J. Murata, sp. nov.
Det. *Thunberg*

Patria

Datum Oct. 5, 2007
Legit

ナギ'ヒロハテンナンショウ
Arisaema sp.

Arac. (332)

Loc. Hyogo Pre. Siso City Tigusacho Mt. Nabegataniyama
兵庫県宍粟市千種町西河内鍋ヶ谷山(岡山県境)
35° 12' N 134° 24' E alt. 1200-1250m
Habitat mountain ridge at the Hyogo-Okayama border

Date 2007.5.23

Coll. Tomiki Kobayashi (小林禰樹) NO. 42827

FIG. 2. Holotype of *Arisaema nagiense* (TI).

elliptic to elliptic, base cuneate, apex acuminate, 4–13.5 cm long, 0.7–7 cm wide. *Inflorescence* unfolding before leaf blade; peduncle much shorter than pseudostem and petiole, 1.5–11 cm long; spathe tube 2.2–4.5 cm long, pale greenish purple, with longitudinal raised white stripes, cylindrical, slightly reflexed and expanded at mouth to base of blade; blade curved forward to declining, outside greenish, inside totally dark purple, narrowly triangular to narrowly triangular ovate, apex long acuminate, 3.5–7 cm long, 1.3–3.0 cm wide. *Spadix* unisexual; appendage dark purplish, yellowish apically, cylindrical, upright, (1–)2–5 mm wide, slightly exceeding spathe tube, basally truncate and stipitate. Staminate flowers of 2 or 3 fused stamens, anther cells globose, dehiscing by short slits to pores. *Ovaries* congested, green, bottle-shaped.

Japanese name. Nagi-hiroha-ten'nansho

Chromosome number. $2n = 26$.

Distribution. Japan: Honshu (Hyogo and Okayama Prefs).

Other Specimens examined. JAPAN. Hyogo Pref.: Siso City, Chigusa-cho, around Mt. Nabegataniyama, alt. 1200–1350 m, 23 May 2007, *T. Kobayashi* 42816, 42822, 42826 (TI). —Okayama Pref.: Katsuta-gun, Nagi-cho, Mt. Nagisan, alt. 900–1100 m, 19 May 2007, *T. Kobayashi* 42814 (TI); Katsuta-gun, Nagi-cho, Mt. Nagisan, alt. 1100 m, 25 May 2007, *K. Sasamura* 531, 536 (TI).

Arisaema nagiense is diploid with $2n = 26$ chromosomes (Fig. 3). It has a narrow distribution range on mountains near the border of Hyogo and Okayama Prefectures. *Arisaema ovale* is also distributed in this area but usually occurs at lower elevations. In that area, *A. ovale* is tetraploid and always has a green spathe and axillary buds accompanied by accessory buds (Fig. 1F). *Arisaema nagiense*, with a spathe blade dark purple inside and solitary axillary buds (Fig. 1E) is readily distinguished from *A. ovale*. In considering the total range of variation of *A. ovale* (including diploid individuals from Abe-toge, Shizuoka Prefecture)

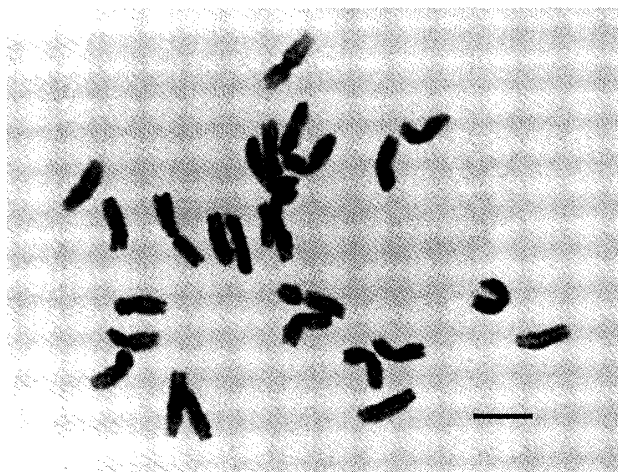


FIG. 3. Somatic chromosomes of *Arisaema nagiense* ($2n = 26$). Scale bar indicates 5 μ m

and *A. nagiense*, they are significantly different in the peduncle/petiole length ratio, width/length ratio of the spathe blade and width/length ratio of the terminal leaflet in both pistillate and staminate individuals, respectively (Table 1). In pistillate individuals the difference in the blade/tube length ratio of spathe is also significant. In the *A. ovale* group *A. nagiense* is unique in the inflorescence unfolding before the leaf blade (Fig. 1B).

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TABLE 1. Comparison of morphological characters in *Arisaema nagiense* and *A. ovale*. Numerals indicate mean, standard deviation and range, respectively.

Characters	<i>A. nagiense</i>			<i>A. ovale</i>		
	female (N = 11)	male (N = 10)	total (N = 21)	female (N = 32)	male (N = 37)	total (N = 69)
Length of pseudostem (cm)	17.3 ± 5.0 (11.0-28.0)	9.6 ± 2.5 (6.0-12.5)	13.5 ± 5.5	26.4 ± 9.0 (8.0-51.4)	18.1 ± 8.0 (2.0-44.2)	22.0 ± 9.4
Length of peduncle (cm)	5.3 ± 2.1 (2.7-10.0)	5.4 ± 2.5 (1.5-9.2)	5.4 ± 2.3	3.5 ± 1.5 (0.8-6.7)	3.6 ± 1.7 (1.0-7.0)	3.6 ± 1.6
Length of petiole (cm)	11.2 ± 2.2 (7.0-14.5)	10.4 ± 3.4 (3.5-15.5)	10.8 ± 2.8	16.6 ± 4.6 (7.8-28.0)	13.0 ± 4.0 (6.3-22.5)	14.7 ± 4.6
Length ratio of peduncle/petiole	0.49 ± 0.21 (0.19-0.91) **	0.52 ± 0.18 (0.27-0.77) **	0.51 ± 0.19 **	0.21 ± 0.09 (0.07-0.39) **	0.30 ± 0.16 (0.09-0.66) **	0.26 ± 0.14 **
Length of spathe tube (cm)	3.8 ± 0.4 (3.2-4.5)	3.2 ± 0.5 (2.2-4.0)	3.5 ± 0.6	4.9 ± 0.7 (3.7-6.5)	4.2 ± 0.7 (2.4-5.5)	4.5 ± 0.8
Length of spathe blade (cm)	5.3 ± 0.8 (4.0-6.4)	5.2 ± 1.1 (3.5-6.8)	5.3 ± 0.9	7.7 ± 1.3 (3.7-10.0)	6.2 ± 1.3 (3.5-8.2)	6.9 ± 1.5
Width of spathe blade (cm)	2.2 ± 0.5 (1.5-2.9)	1.7 ± 0.2 (1.3-2.0)	1.9 ± 0.5	4.0 ± 0.6 (2.5-5.0)	3.6 ± 0.7 (1.9-5.0)	3.8 ± 0.7
Length ratio of spathe blade/tube	1.40 ± 0.13 (1.21-1.64) *	1.64 ± 0.18 (1.34-1.94)	1.53 ± 0.20	1.59 ± 0.28 (0.97-2.19) *	1.50 ± 0.27 (0.90-2.08)	1.54 ± 0.28
Width/length ratio of spathe blade	0.41 ± 0.11 (0.28-0.55) **	0.33 ± 0.05 (0.26-0.40) **	0.37 ± 0.09 **	0.52 ± 0.09 (0.34-0.73) **	0.59 ± 0.14 (0.37-1.11) **	0.56 ± 0.12 **
Width of spadix-appendage (mm)	3.3 ± 1.0 (2.0-5.0)	2.3 ± 0.8 (1.0-3.5)	2.8 ± 1.0	4.0 ± 1.2 (1.6-6.4)	3.9 ± 1.3 (1.7-6.4)	3.9 ± 1.3
Number of leaflets	4-6	5-7	4-7	5-7	5-7	5-7
Length of terminal leaflets	10.3 ± 2.2 (7.0-13.5)	8.4 ± 2.6 (3.5-11.9)	9.4 ± 2.5	15.0 ± 3.8 (6.9-24.0)	10.3 ± 3.0 (2.5-16.5)	12.5 ± 4.1
Width of terminal leaflets	3.4 ± 1.5 (1.8-6.8)	1.9 ± 0.7 (0.7-3.1)	2.7 ± 1.4	6.8 ± 2.0 (2.5-12.0)	4.6 ± 1.5 (1.0-7.3)	5.6 ± 2.1
Width/length ratio of terminal leaflet	0.33 ± 0.12 (0.18-0.59) **	0.22 ± 0.05 (0.15-0.30) **	0.28 ± 0.10 **	0.46 ± 0.08 (0.25-0.64) **	0.44 ± 0.09 (0.23-0.60) **	0.45 ± 0.09 **

“Asterisks denotes significant difference in female vs female, male vs male and total vs total, respectively (*t*-Test, ***P* < 0.01, **P* < 0.05).”

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